International Journal of Latest Trends in Engineering and Technology
Vol.(9)Issue(4), pp.155-160
DOI: http://dx.doi.org/10.21172/1.94.25
e-ISSN:2278-621X

PARAMETRIC ANALYSIS OF NOVEL ENHANCED BANDWIDTH EFFICIENT CLUSTER-BASED MULTICASTING PROTOCOL (NEBECM)

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Abstract-Vehicular network comprised large number of vehicular nodes that have high speed of mobility in comparison to the nodes of other ad hoc networks. Due to the large number of available nodes and high mobility of the nodes, the task of cluster creation becomes difficult as it becomes tedious to cover all the nodes in the clusters. On the other hand, the non-clustered nodes are not capable to perform the communication with cluster members and multicast members. Thus in order to resolve this issue, NEBECM (Novel Enhanced Bandwidth Efficient Cluster-based Multicasting) protocol is developed. The communication between non-clustered node and sink is done through a near located cluster. The result provides a comparison between NEBECM with EBECM and BEAM in the terms of packet delivery ratio, routing overhead and throughput of the network and assures the proficiency of proposed work over EBECM (Enhanced Bandwidth Efficient Cluster-based Multicasting) and BEAM (Bandwidth Efficient Acknowledgment Based Multicasting Protocol).
Keywords—Vehicular Ad hoc Networks, Data Dissemination, Cluster Head Selection, Throughput, Packet Delivery Ratio, Routing Overhead

1. INTRODUCTION

Ad Hoc Networks are the wireless networks which poses the property of self-organizing or did not follow any physical infra to settle down in the environment. Nodes or hubs in specially appointed systems (Ad Hoc Networks) act as both client and router. Including helpful versatile data interchange and few usages of specially appointed systems could incorporate mechanical and business applications. [1], such as military, security process etc. As of late, developing advances, for example, remote sensor systems (WSNs), wearable computing, Internet of Things, have a great extent added to a further push toward application possibilities of specially appointed systems [2]. VANETs are a type of ad hoc networks which supports the ample assortments of on road applications. Thus, VANETs requires proficient and effectual radio resource control tactics. The vehicles in VANETs are deployed as per the rules of ad hoc networks, but still, VANET is different from MANET in the terms of network topology, mobility pattern, energy constraints and real life applications. Hence, the techniques modeled for MANETs are not suitable to the VANET directly. In order to understand the applications of VANETs in vehicular environment, trending and effective tactics that are meant particularly for VANETs are needed to be employed. Following is the key domains for research in VANETs [3]:

1.1 Frequent Link Disconnection:

It is known that the mobility of vehicles in VANETs is high in speed in comparison to the mobility of the nodes in other ad hoc networks. Therefore the topology of the VANETs keeps changing frequently which leads to the link disconnection.

1.2 Highly dynamic Spatio-temporal traffic conditions:

The variation in density of the vehicular nodes can be seen, as when the nodes are on highway has very small density and when located in a jam within a city then the density goes very high. The flow of vehicles in VANETs is dynamic in nature and highly realize upon the time factor. Hence to handle the variations in spatio-temporal traffic situation is required and yet challenging issue [4].

1.3 Heterogeneity of applications:

VANETs supports wider range of infotainment and road safety applications. The low delay and high reliability are the basic and major requirement of road safety applications. Whereas for infotainment based applications higher throughput, low packet loss, better resource management are the major needs. For assorted applications, it is must that the channel protocols and network resource utilization technique should be perfect so that the vehicular nodes can perform efficient and effective communications. In VANETs the data packets travel in the sequence on the basis of their assigned priorities which could be high or low. Thus to establish a proficient communication technique for ensuring safety of the vehicles on roads by offering a qualitative services for dynamic vehicular network.

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1.4 Data dissemination:

The dissemination of traffic related data is one of the major challenging issues in VANETS. In comparison to other networks where, the flow of date is unicast, the traffic related should be of such nature which required broadcasting in the network instead of routing. Data dissemination is a process in which the data is distributed over a distributed network. It is specifically done to improve the traffic system in a network. It looks simple and easy but it is quite difficult when comes to the implementation. Because it is not easy for a vehicle to perform communication in the presence of large number of vehicles. Hence it becomes tedious to perform communication or data transmission in network [5].

2. COMPARISON OF EXISTING DATA DISSEMINATION TECHNIQUES

There are various data dissemination techniques that are used to perform equal and fair data distribution in a vehicular network. The dissemination techniques are:

1. Peer to Peer
2. V2I/I2V
3. Cluster based
4. Opportunistic
5. V2V

The comparison among data dissemination techniques are below:

Table 1: comparison of data dissemination techniques [2]

Dissemination type	Dissemination approach	Advantages	Disadvantages
Cluster based dissemination	Creates the clusters	It facilitates the high data delivery rate and lower delay in data delivery.	It did not allow all the nodes to distribute the data.
P2P	Perform Store and forwarding of the data on asking	Most suitable to the delay tolerant applications.	Messages are not forwarded to the network.
Opportunistic	Store and forward	Create dynamic paths	It follows the data centric prototypes hence id not concerned with right delivery of the data.
V2I/I2V	Push based	Appropriate to the popular data	Not applicable to the non-popular data.
	Pull based	Mostly appropriate to the non-popular data or user specific data.	Faces heavy interference and collisions due to cross traffic.
V2V	Relaying	Suitable to dense and congested networks.	Selection of next hop is quite difficult task.
	Flooding	Perform data distribution in an effective and quick manner.	Not applicable to dense and congested networks.

The above table come to a conclusion that existing data dissemination protocols has been suffering from several issues such as heavy interference, collisions, difficulty in selecting next hop, low throughput and packet delivery ratio. Considering these problems, a new protocol NEBECM has proposed in this paper termed as Novel Enhanced Bandwidth Efficient Cluster-based Multicasting Protocol. The primary focus of this protocol is to communicate through non-clustered nodes. In order to confirm the performance of proposed protocol, a comparative analysis will be carried out in the next section using traditional protocols such as EBECM and BEAM. Based on their comparative analysis, it can be accomplished that an improvement has been done in the proposed technique in terms of different parameters such as Throughput, Packet Delivery Ratio and routing overhead.

3. PROPOSED WORK

As it is known that, while performing clustering some nodes remain un-clustered. Then it becomes impossible for such nodes to perform communication with the cluster members or other nodes. Thus a Novel Enhanced Bandwidth Efficient Cluster-based Multicasting Protocol (NEBECM) is proposed in this work. This study is the continuation of the last study which provided the results of the proposed work in the terms of the throughput, packet delivery ratio and routing overhead. The objective of the NEBECM is using the non-clustered nodes in the communication in case of emergency. This is done firstly by evaluating the distance of node to the cluster heads and then the nearly located cluster head grants the permission from the communication center and revert back to the non-clustered node. Hence, the non-clustered node communicates to the cluster nodes through near located cluster. This study is representation of the comparison of NEBECM and EBECM protocols. The strategy of the proposed work is as below:

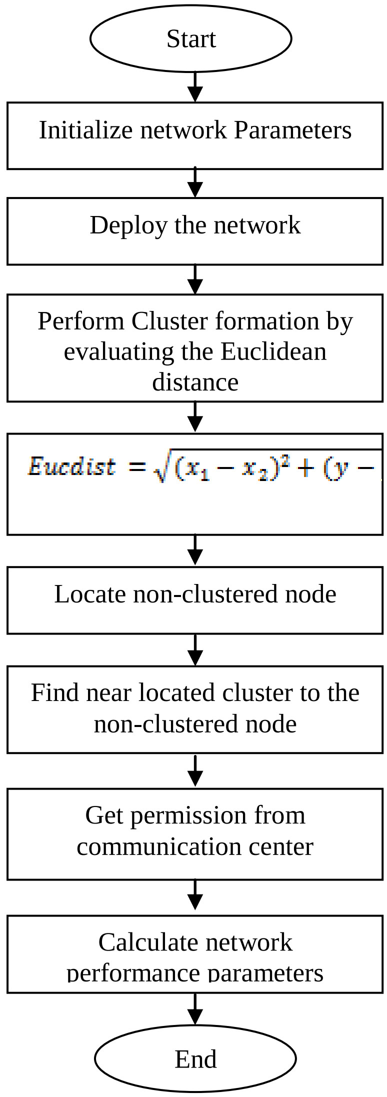

Figure 1: Algorithm of NEBECM

4. EXPERIMENTAL RESULTS.

This section of the study is comprised of the comparison of the NEBECM with EBECM and BEAM in the terms of packet delivery ratio, routing overhead and throughput of the networks. The results are obtained by implementing the proposed work in the NS2 platform. NS2 is a discrete event computer based network simulator. The comparison is performed on the basis of the throughput of the network, packet delivery ratio and routing overhead.

The graph in figure 2 depicts the comparison of NEBECM with EBECM and BEAM techniques. The x axis in the graph represents the time which starts from 1 second to 6 second. The y axis in the graph calibrates the data in the terms of throughput that ranges from 15 to 65. The line in red color represents the throughput of the NEBECM and line in green depicts the throughput corresponding to the EBECM and line in blue represents the throughput for BEAM. The highest value of throughput shows that the system is more reliable.

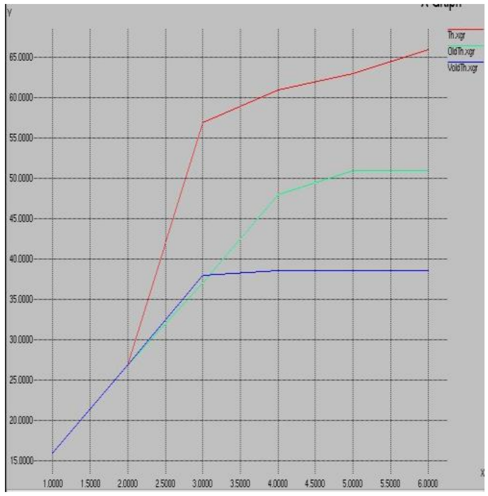

Figure 2 Comparison of throughput

The table 2 shows the values that are obtained from the graph of figure 2. The table represents the throughput and simulation time with respect to the NEBECM, EBECM and BEAM. On the basis of the observed values it can be concluded that the proposed system has highest throughput i.e. 65.96 kbps in comparison to the EBECM i.e. 51 kbps and BEAM has only 38.6 kbps.

Table 2: Simulation v/s Throughput

Simulation Time	Throughput (kbps)		
	NEBECM	EBECM [2]	BEAM [10]
0.00	0.00	0.00	0.00
1.00	16.00	16.00	16.00
2.00	27.00	27.00	27.00
3.00	56.96	37	38
4.00	60.96	48	38.6
5.00	62.96	51	38.6
6.00	65.96	51	38.6

The figure 3 plots the graph of simulation time v/s packet delivery ratio in NEBECM, EBECM and BEAM. The packet delivery ratio of a network should be high so that the network can assure the high data delivery rate.
Table 3 shows the values of packet delivery ratio with respect to the simulation time in three of the protocols. The NEBECM has the highest packet delivery ratio i.e. 1.00 at 6 sec whereas for EBECM and BEAM it is evaluated to 1.0 and 0.94 at the same interval.

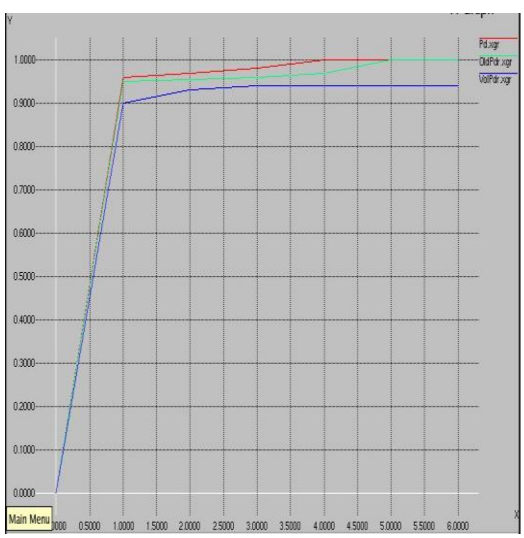

Figure 3 Comparison of PDR

The facts depicted in the table 3 are derived from the graph of figure 3. It calibrates the data in the terms of packet delivery ratio and simulation time in NEBECM, EBECM and BEAM. From the results evaluated, it has been concluded that NEBECM is 2% higher than the EBECM and 5% higher in comparison to the BEAM.

Table 3 Simulation time v/s PDR

Simulation Time	PDR		
	NEBECM	EBECM [2]	BEAM [10]
0.00	0.00	0.00	0.00
1.00	0.96	0.95	0.90
2.00	0.97	0.955	0.93
3.00	0.98	0.96	0.94
4.00	1.00	0.97	0.94
5.00	1.00	1.00	0.94
6.00	1.00	1.00	0.94

The figure 4 portrays the graph of routing overhead that is observed after implementing the proposed work in NS2. The x axis depicts the simulation time which ranges from0.00 to 6.00 and y axis represents the routing overhead from 0.00 to 4.50. The routing overhead of the proposed work is low in comparison to the rest of the two techniques.

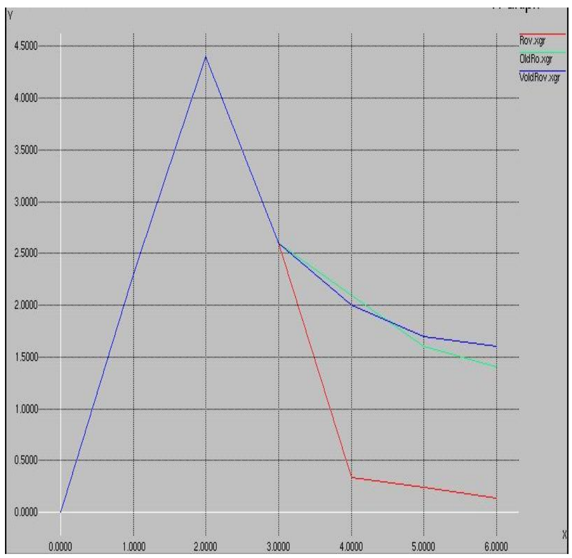

Figure 4 Comparison of routing overhead

The table 4 represents the routing overhead with respect to the simulation time. The comparison is done among proposed work, EBECM and BEAM. The table proves that the proposed work suffers from lower routing overhead i.e. 0.14 at 6 seconds whereas the EBECM and BEAM suffers from highest routing overhead such as 1.4 and 1.6 at 6 seconds respectively.

Table 4: Simulation v/s routing overhead

Simulation Time	Routing Overhead		
	NEBECM	EBECM[2]	BEAM [10]
0.00	0.00	0.00	0.00
1.00	2.30	2.30	2.30
2.00	4.40	4.40	4.40
3.00	2.60	2.60	2.60
4.00	0.34	2.1	2.0
5.00	0.24	1.6	1.7
6.00	0.14	1.4	1.6

5. CONCLUSION AND FUTURESCOPE

It is concluded in this work that the data dissemination is one of the tedious task to perform in VANETs because in vehicular networks the mobility of the nodes is so high that becomes difficult for one node to communicate with another node. This study developed NEBECM i.e. Novel Enhanced Bandwidth Efficient Cluster-based Multicasting Protocol which provides a facility to the non-cluster nodes to perform communication with other nodes in the network. The results depicts that the throughput of the proposed work is 65.96 kbps, for EBECM it is 51 kbps and for BEAM it is 38.6 kbps. Hence it is proved

that the throughput of the proposed work is quite higher in comparison to the EBECM and BEAM. The evaluated packet delivery ratio of the NEBECM is 2% higher than the EBECM and 5% higher in comparison to the BEAM. The routing overhead of NEBECM is 0.14, in EBECM it is 1.4 and for BEAM it is 1.6 which is higher in both cases i.e. EBECM and BEAM in comparison to the NEBECM.
In future, more work can be done on the cluster head selection strategy to reduce the number of non-cluster nodes in the network.

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